

HR-352 Stream Stabilization in western Iowa

Key Words: Erosion, Stream Stabilization, Loess Soils, Western Iowa,

ABSTRACT

Stream channel erosion in the deep loess soils region of western Iowa causes severe damage along hundreds of miles of streams in twenty-two counties. The loess derived alluvial soils in the stream channels are highly susceptible to erosion resulting in bed level degradation and subsequent bank widening. Stream channel depths and bank widths have eroded from five to ten times greater than at the beginning of the twentieth century, thus threatening the structural safety of thousands of bridges, damaging pipelines and communication lines, and resulting in the loss of productive agricultural land.

Section two of this report presents an assessment of stream channel conditions from aerial and field reconnaissance conducted in 1993 and 1994 and a classification of the streams based on a six-stage model of stream channel evolution. A Geographic Information System is discussed that has been developed to store and analyze data on the stream conditions and affected infrastructure and assist in the planning of stabilization measures.

Section three of this report presents an evaluation of two methods for predicting the extent of channel degradation. The first method is a geomorphic approach that identifies the stable reach of a stream and graphically projects the longitudinal profile upstream into the degrading reach to estimate the future amount of degradation. The second method evaluated is an analytical iterative process of balancing applied tractive force with erosion resistance.

Section three also discusses the application of grade control structures; a counter measure to the threat of damage to infrastructure from channel erosion. A planning procedure for identifying the most effective location for and height of grade control structures is presented along with an economic analysis of currently used grade control structures.

Section four of this report presents an estimate of costs associated with damages from stream channel erosion since the time of channelization until 1992. The estimated damage costs to highway and railroad bridges, pipelines, telephone, electric, and rural water lines, and lost agricultural land of five streams were used to estimate the total costs of 155 eroding streams in western Iowa. The estimated time neutral cost of the 155 streams is \$174.9 million. The estimated time value cost, which recognizes the time value

of money, is \$1.1 billion. Damage to highway bridges represents the highest costs associated with channel erosion, followed by railroad bridges and right-of-way; loss of agricultural land represents the third highest cost.

An estimate of costs associated with future channel erosion on western Iowa streams is also presented in section four. Four streams and their tributaries were examined in detail. A predictive model together with field data was used to estimate future stream widening. The costs associated with future damages to public and private infrastructure and land voiding resulting from predicted stream widening were then estimated. The results from these four streams were generalized to 102 actively eroding streams and their tributaries. The time neutral future costs are estimated at \$177.3 million. The time value future costs are estimated at \$70.1 million.

Section four also presents a procedure to estimate the benefits and costs of implementing stream stabilization measures. The procedure is applied to evaluate the benefits and costs of installing a grade control structure on Keg Creek in Pottawattamie County. The procedure uses models to predict future stream bed degradation and widening. Benefits of channel stabilization are estimated in terms of the avoidance of damages to infrastructure and lost farmland which would have occurred due to continued channel erosion. The estimated costs are those associated with installation of the selected stabilization measure. The analysis of the Keg Creek site resulted in a benefit-cost ratio of 1.49.

Section five of this report presents information on the development of the organizational structure and administrative procedures which are being used to plan, coordinate, and implement stream stabilization projects and programs in western Iowa. The Degrading Streams Task Force, comprised of representatives from eight counties in southwest Iowa, provided the initial structure and procedures to address the problem of stream channel erosion. Efforts of the Task Force led to the formation of a non-profit organization called the Hungry Canyons Alliance in 1992. The Alliance, which consists of 21 western Iowa counties, formalized the structure and procedures established by the Task Force. They worked successfully to achieve authorization of the Loess Hills Development & Conservation Authority in the Iowa Legislature in 1993. Membership in the Authority is comprised of county supervisors, county engineers, soil and water conservation district commissioners, and interested people from a twenty two county area. The Authority plans and carries out projects related to stream channel erosion with technical and financial support from federal, state, and local agencies.